inscriptions that even the Deir-el-Bahari find is not to compare with the inscriptions on the temples of Denderah and Edfu, and those of the caves of Siut.

HYDROGRAPHICAL SURVEYING

Hydrographical Surveying; a Description of the Means and Methods employed in constructing Marine Charts. By Capt. W. J. L. Wharton, R.N. (London: Murray, 1882.)

CAPT. WHARTON, who has had considerable experience in nautical surveying, having been in command of surveying vessels for nearly ten years, has devoted his time, during the short interval he has been unemployed, to writing a work on this part of the naval profession which he modestly describes, in his preface, as an endeavour to collect together information, which has existed for years in a traditionary form amongst surveyors, for the benefit of young officers who may wish to devote themselves to surveying work in the future.

A book of this sort was certainly much needed as since the time of Sir Edward Belcher, only one treatise has been written by a naval surveyor—Capt. R. Mayne, R.N., C.B.—and we think Capt. Wharton deserves the thanks of the profession for his exertions, and we hope to see his work adopted as the text-book for instruction at the Royal Naval College.

Before however reviewing Capt. Wharton's treatise we propose to state briefly what we consider to be the requirements of a nautical survey.

The perfection of marine surveying appears to us to be the representation in a graphic form, readily understood, of the coasts and harbours of the world with their various off-lying dangers; marking distinctly the various features of high and low water lines, showing the dangers to be avoided and the channels available for navigation, placing prominently on the chart those objects on the land which serve best to ascertain the position of a ship, and subordinating all other features to these objects, so that the channels to be used, and the marks by which those channels can be recognised, are easily distinguished; as well as representing the set of the tides and currents and the errors of the compass. To execute such a survey it is evident considerable care must be bestowed in ascertaining accurately the positions of the land marks, as on these depend the whole of the work, but this accuracy need not be carried to such a degree of minuteness that it cannot be shown on the chart; for, after all, the principal object of a *chart* is to show the soundings; and enough care has been bestowed on the land-marks if their positions are ascertained with sufficient precision for soundings. Of course circumstances occasionally arise when, from other causes, it may be advisable to modify this arrangement, but not for the purpose of navigation.

Capt. Wharton appears to have kept these objects steadily in view in writing his work. The work commences with a description of the instruments used in nautical surveying, which, although previously given by Heather and by Simms, cannot be considered out of place, and then gives a description of marine surveying in general, afterwards entering into particulars. We regret that in the description of the sextant the important errors of centering and graduation have been overlooked.

We much commend the following remark at p. 54, too often ignored by surveyors:—"The accuracy necessary in many details of a chart depends very much upon its scale. Over-accuracy is loss of time. Any time spent in obtaining what cannot be plotted on the chart is, as a rule, loss of time."

Of course the scale on which a survey should be executed should be settled after due consideration. It is evident that an inaccessible coast, off which there is deep water, does not require the same accuracy of delineation as a coast studded with bays and harbours, or off which numerous dangers exist; or those portions of the globe little frequented by shipping the same care as the coasts of the United Kingdom. These points must to a great extent be left to the officers in charge of a survey, but the scale once settled no time should be wasted over details which cannot be shown on that scale.

Capt. Wharton's remarks on soundings are excellent. There is no doubt that this, the most important work of the marine surveyor, is very monotonous. To sit in a boat day after day, from early morn to dewy eve, marking in a book soundings and angles, with the salt from the spray drying up one's skin, and the sun blistering one's nose requires more than ordinary zeal, patience, and perseverance; and only long practice enables the surveyor to really take an interest in this work. Young surveyors should, however, remember, that every other detail is subordinate to this, and that until they can really sound, thoroughly, over a given patch of ground without loss of time they cannot be considered masters of the profession.

Capt. Wharton's remarks on obtaining latitudes and running meridian distances are excellent. We think indeed that, in the latitude, the same results might be obtained with less figures, but it is by no means easy to draw a hard and fast line.

In the remarks on tides, no mention is made of the importance of referring the result obtained to a fixed mark on the shore, nor any observation as to the diurnal inequality, and consequently the necessity of, on all occasions, when practicable, registering both day and night tides. In the Eastern Archipelago the diurnal inequality is in some places 4 to 5 feet, and in Australia the mean tide level also differs at different times. These facts appear to have escaped Capt. Wharton's notice, but probably will be inserted in another edition.

In the remarks on searching for Vigias, and ascertaining the position of a ship at sea, Capt. Wharton seems to think accurate observations cannot be obtained, as he asserts the position of a ship to be doubtful to three miles.

On this point we must differ from him, as long experience has proved, to our own satisfaction, that provided the weather is fairly clear the position of the ship can be obtained to half a mile. Nor in asserting this do we rest on single evidence, as Capt. Moriarty, R.N., C.B., in the *Great Eastern*, had no difficulty in picking up the end of the Atlantic cable when it had been slipped from the ship.

The fact is the great error in sea observations is due to the refraction of the horizon, but it must be borne in mind that, excepting in shallow water, this is but slight, and that it can always be corrected by observing on opposite sides of the horizon.

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By taking advantage also of the bright planets passing the meridian in the day time good observations can be obtained for latitude and longitude *at the same time* (a great point), whilst the sun is above the horizon, as well as at sunrise and sunset, when by Sumner's method three or more stars can be combined to give the position. We admit that constant practice is required to take these observations accurately, but they *can* be obtained, and as it is very useful to be able to make certain of a ship's position, as often as possible, all officers should practise themselves in observing both Venus and Jupiter with the sun above the horizon.

Whilst however not agreeing with Capt. Wharton on some few points, we think his work will be found most useful, not only for young officers taking up surveying but also as a book of reference for older surveyors, and personally feel much obliged to him for combining in one volume so many useful remarks and tables which have hitherto been only in MSS. or pamphlets.

THE HORSE IN MOTION

The Horse in Motion as shown by Instantaneous Photography; with a Study on Animal Mechanics, founded on Anatomy and the Revelations of the Camera, in which is demonstrated the Theory of Quadrupedal Locomotion. By J. D. B. Stillman, M.A., M.D. Executed and Published under the Auspices of Leland Stanford. (London: Trübner and Co., 1882.)

THE above is the somewhat long title of a large and important work issuing from the well-known Cambridge (U.S.) University Press. Long as is the title, the name of the principal contributor to the volume is left unrecorded there, though indeed even a cursory glance over its contents shows how much indebted is the whole question of the mode of motion in the horse to the elaborate series of investigations of Mr. J. Muybridge.

Leaving aside the anatomical and teleogistic arguments of Dr. Stillman, as contained in some hundred pages of letterpress, we cull from a postscript to the same the following interesting information, which we give as we find it in the book. Some time in 1872, Mr. L. Stanford, of Palo Alto Farm, in California, had his attention called to the very controverted question as to the action of a trotting horse, and conceiving the idea that the photographic camera might be made available to illustrate the action, he, according to the authority before us, consulted with Mr. Muybridge and induced him to undertake some experiments in instantaneous photography. Some ten years ago, a photograph taken in the space of the one-twelfth of a second was considered quite a success, and it would seem that the experiments made then by Mr. Muybridge were inconclusive. In 1877 Mr. Muybridge, however, renewed his experiments. A few pictures were taken of "Occident," a noted trotter belonging to Mr. Stanford, while he was in motion, and one of these, representing the horse with all his feet clear of the ground was enlarged, retouched, and distributed. This result was so extraordinary and so successful, that it was determined to try others on a more extended scale. It was assumed that if one picture could be taken instantaneously, an indefinite number might also be taken, and so the various positions assumed by the horse in a single complete stride could be illustrated.

Mr. Muybridge was authorised to procure the needed apparatus, and a building suitable to the purpose was erected on Mr. Stanford's farm. By 1878 preparations were complete, and every resource of the photographic art had been provided. Twelve cameras were placed in the building at intervals of twenty-one inches, with double shutters to each, and these shutters were so arranged that the whole series of exposures were made in the time occupied by a single complete stride of a horse. The very ingenious mechanism invented by Mr. Muybridge it would be impossible to describe without the assistance of illustrations, but it may be stated that he was thereby enabled to double the number of his cameras, and the whole of the large series of twenty-four figures each, which are used to illustrate this volume, were taken by him. They were very accurately taken, and the heliotypes are perfect transcripts of the original photographs.

Thanks to the zeal and energy of Mr. Muybridge, and the liberality of Mr. Stanford, we are now enabled to see for ourselves the various attitudes assumed by a horse in running, trotting, leaping, and the result is most strange. It would seem as if most civilised nations had failed to recognise the true action of this noble quadruped, as if all had settled down into being content with a conventional idea of how a horse in motion ought to be represented. Now our artists will have no excuse; they can directly interrogate nature, as represented to them in these silhouettes, no doubt at first they may follow her with fear, for some of the positions look strange, not to say grotesque, but soon both artist and the public will have learnt to recognise the truth: and once this is so, the old style will be in its turn regarded as grotesque, and as representing but an early stage in the development of art.

Mr. Muybridge's photographs will be of immense importance to all art students, and they should be attentively studied by all admirers of the horse. A few other photographs are given in this volume of the various stages of motion in the cow, dog, deer, and boar.

OUR BOOK SHELF

Unexplored Báluchistán: a Survey of a Route through Mekrán, Bashkurd, Persia, Turkistan, and Turkey. By Ernest A. Floyer. (London: Griffith and Farran, 1882.)

AN entertaining book of travel, but by no means an exploration of "Unexplored Báluchistán," as is indeed sufficiently evident from the sub-title. Nevertheless, Mr. Floyer has investigated and partly solved some interesting geographical questions in the little-known province of Bashkurd (Bashakard), on the Perso-Mekrán frontier, which he visited on two separate occasions during the years 1876-7. This region, which had been merely skirted by Goldsmid, Lovett, Ewen Smith, St. John, and others connected with the Perso-Balúch Boundary Commission of 1872, and with the development of telegraphy in Persia and Mekrán in 1873-4, was ascertained to comprise six separate territories or districts — Gavr and Parment in the east, Jagda in the west, Marz and Pizgh north and south respectively, and Daroserd with the capital, Angurhán, in the centre. The town, which appears to be a place of great natural strength, was found to lie in 26° 40′ N. lat., 57° 55′ E. long., or about thirty miles from the position assigned to it on Major St. John's map. The Aphen-i-Band range, between Daroserd and Pizgh, was crossed near its western extremity, and ascertained to run east and west under 26° 30′ N., at a mean elevation of 3600

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